Manganese, vanadium, gallium and rare earth elements in the GEOTRACES North Atlantic zonal section

PROJECT SUMMARY

Intellectual Merit: We will determine the distributions of manganese, vanadium, rare earth elements (REEs) and gallium in the proposed GEOTRACES North Atlantic Zonal Section. This section has been carefully constructed to allow researchers to investigate trace elements in various oceanic processes/phenomena including: a) the meridional overturning circulation, b) carbon cycle, c) ocean margin exchange, d) atmospheric inputs, and e) hydrothermal sources and sinks. The elements we propose to study will most especially allow us to investigate cross margin exchanges, redox processes and atmospheric inputs. While each element can be studied individually, the combination of these particular elements allows for some synergy. For example, redox processes affect Mn, V, and REEs (i.e., the Ce anomaly), but each in somewhat different ways. Likewise, Ga can be help separate the reducing and atmospheric inputs of Mn. Furthermore, Ga, as a less-reactive analogue for Al, provides a useful counterpoint to using Al as a tool for understanding dust inputs to the ocean. And Mn, which has similar sources to Fe but a slower oxidation rate, can be used to shed light on the source and potential availability of nano-nutrient Fe.

Some specific objectives of this work include: 1) examine the discrepancy between surface water Ga and Al distributions and estimates of dust input, 2) confirm the relationship observed in the North Pacific between the surface ocean Ga/Al ratio and the chlorophyll distribution, 3) compare the surface ocean Mn distribution with that of Ga and Al as a means of separating shelf and dust inputs, 4) determine if there is evidence of shelf V removal which contributes to the surface ocean V depletion, 5) determine if changes in both REE concentrations and anomalies (e.g., Ce anomaly, light/heavy REE ratios) are associated with environmental gradients in particle flux and productivity, and 6) test for hydrothermal influences on V and REE distributions downstream from the TAG hydrothermal field.

Broader Impacts: As noted in the GEOTRACES Science Plan: *"Trace elements and isotopes* [TEIs] *play important roles in the ocean as nutrients, as tracers of processes now and in the past, and as contaminants. Their biogeochemical cycling has direct implications for research in such diverse areas as the carbon cycle, climate change, ocean ecosystems, and environmental contamination.....Improved understanding of the biogeochemical cycles and large-scale distributions of TEIs will inform many areas of environmental research, from climate science to planning for future global change."* The research proposed here will contribute to that effort, especially with regard to increased understanding of cross margin exchange of elements and atmospheric inputs. Besides this sort of general scientific and societal benefit, the work will lead to the training of a graduate student. Additionally, the knowledge and experience gained from this project will be incorporated into the PI's graduate course in marine chemistry. Results of this work will be broadly disseminated by publication in peer-reviewed journals: the PI has a good record of publishing results from his similar prior research. This proposal also includes a request for funds to participate in a podcast that is both available on the web and broadcast daily over hundreds of radio stations.